SEXUAL SELECTION AND THE NESTING OF BIRDS.

BY J. A. ALLEN.

MR. HENRY DIXON, in a paper 'On the Protective Colour of Eggs,'* follows Mr. A. R. Wallace in dividing "birds into two great classes—one in which the sexes are alike and of conspicuous or showy colours, and which nidificate in a covered site; and the other in which there is a marked difference between the colour of the sexes, the male being showy and the female sombre, and which nidificate in an open site"; and he subdivides them "into several minor groups, which will include all the 'exceptions' to either great rule." Having once written on this subject† I return to it reluctantly, and only because there seems to be something still to say on the other side.

Mr. Dixon's first group consists of "Birds in which the plumage of the male is bright and conspicuous in colour, and that of the female dull and sombre, and which nidificate in open sites." Under this heading, in referring to the fact that "the plumage of the female bird is in a great many cases far more sombre than that of the male," he says: "Until recently the cause of this phenomenon was never dreamed of. It is an ascertained fact that the colour of many female birds is connected in no small degree with their *mode of nidification*, and that the sitting bird is protected by the harmony which exists between its own sober plumage and the colour of the surroundings of its nesting-site. Let us glance over the nesting-habits of some of our best-known birds, and learn the working of this law." As examples of this great group he cites certain Pheasants and Grouse, various Ducks, the Blackbird (*Merula merula*) and Ring-Ouzel (*M. torquata*), several Finches and the Stonechat (*Pratincola rubicola*), in which 'the diversity of plumage between the sexes' shields the female during the season of nidification. In most of the instances cited this is eminently true, but there are glaring exceptions. Indeed, it will readily occur to ornithologists that several

* In Seebohm's 'History of British Birds,' Vol. II, Introduction, pp. x-xxxii.

† See paper entitled 'An Inadequate "Theory of Birds' Nests,"' in Bull. Nutt. Orn. Club, Vol. III, 1878, pp. 23-32.

species of birds of the groups here instanced—species too in which the sexual difference of plumage is at a maximum — resort to hollow trees for greater safety, as is the case with the Wood and Mandarin Ducks (genus *Aix*), the Buffle-heads (genus *Clangula*), and the Sheldrakes (Merginæ). In other cases, as in our brilliantly colored Grosbeaks, where the female is dull-colored as compared with the male, the male shares in the work of incubation, and is even so indiscreet as to indulge in ecstatic outbursts of song while sitting on the eggs.

Mr. Dixon's second group consists of "Birds in which the plumage of both sexes is showy or brilliant in colour, and which nidificate in open nests." "This group," Mr. Dixon says, "forms one of those exceptions which, at first sight, appears seriously to affect the reliability of the whole theory"; but he believes "it can be shown that the birds included in it may possibly secure their safety in other ways." Unquestionably this is the case; at least they appear to get on quite as well as do the plain plumaged open nest builders. It certainly is true that, as our author states, many "brightly plumaged birds are safe enough in the localities where they build their nests." Mr. Dixon even suggests that "Some gaily attired female birds may have no special enemies against which to guard—their brilliant or showy dress is no disadvantage to them, as is the case with many conspicuous insects; and this fact may in itself explain why it is that they have assumed such tints." He even supposes that as some brilliant females may have become so through natural selection, they may have altered the form of their nest from an open to a covered structure; "and this would explain many of the apparent exceptions to the general rule that gaily dressed female birds sit in covered nests." Unfortunately this is not susceptible of proof, while the probabilities seem quite against the supposition. It is true, as he adds, that we should "also take into consideration what colours are showy in certain haunts,"—that while they would be "very conspicuous in some places they may be especially protective in others."

The third and last group of open nest builders instanced consists of those few species "in which the male is less brilliant than the female," as the Phalaropes, Dotterel, Emu, etc.

Passing to the second great division, 'in which the nests are concealed,' the first group mentioned is composed of "Birds in

which both sexes are brightly coloured and which rear their young in holes or covered nests." As British representatives of this group are cited the Kingfisher, the Woodpeckers, the Tits, Gold-crests (Kinglets), and Nuthatches, the "showy Swallows and Martins," the "gaudy Rollers and brilliant Bee-eaters," the Hoopoe, Wall-Creeper, and Common Sheldrake, in which both sexes are equally conspicuous and nest in holes. Reference is also made to the American Orioles (Icteridæ) and several Australian birds.

The next group consists of "Birds in which both sexes are dull in colour, and which build covered nests from motives of safety other than concealment." Respecting this group Mr. Dixon says, "I do not think that the fact of dull-coloured females sitting in covered nests can be taken as a serious objection to the law of bright-coloured females sitting in covered nests": and cites the many other obvious advantages mentioned by Darwin in his 'Descent of Man' (Vol. II. p. 168), as protection from enemies or the elements. These advantages are in many cases so evident that it seems unnecessary to call in the far-fetched explanation that plain-colored birds nest in this way because they 'may' have descended 'from some showy ancestor that built in a covered nest.' A number of instances are then cited showing the advantages other than concealment of a covered or domed nest, or of nesting in holes in trees or banks. Other instances of covered nests (presently to be cited) might have been added to show that such nests are often constructed to serve especially as protection from enemies.

The next group mentioned is that of "Birds in which the female is duller in colour than the male, and which nidificate in covered nests"; and which is cited as furnishing "convincing proofs of the theory of sexual selection"(!). Yet after mentioning various species and genera of birds in which 'the female is far less brilliant than the male,' it is suggestively admitted, "nevertheless she sits in a covered nest, although we cannot see any valid reason why she should require *concealment* during the period of incubation; in all cases her colours are dull and well adapted for safety in an open nest." Among the 'possible explanations' suggested is the very rational one that the domed nests "may be for the purpose of shielding the sitting bird and its charge from cold, or rain, or from some special

enemies." Again, it serves to conceal the eggs, where they are, as in many cases, conspicuous; and also allows the gaudily plumaged male bird to assist in incubation; yet this also happens when the nest is an open one. "If we grant," says Mr. Dixon, "that these domed nests are built for other purposes than concealment of the sitting female, it is easy to explain the great difference of colour between the sexes. The more brilliant colours of the males have been obtained by sexual selection"; and proceeds to cite cases where the domed nest is evidently not built for the purpose of concealing the female. This dictum, however, appears to be the only 'proof' educed from the consideration of this group, which furnishes such "convincing proofs of the truths of the theory of natural selection." The author then considers 'Birds' Nests' and 'Birds' Eggs, studied in relation to their colour.' The last subject is treated at some length in a thoroughly rational and admirable manner, but respecting 'Birds' Nests' we beg to offer one or two criticisms. But first let us return to the first part of the subject, the coloration of female birds in respect to the manner of nesting.

In my former paper on this subject I ventured to say, "The most surprising thing about Mr. Wallace's 'Theory of Bird's Nests' is its inadequacy, and its irrelevancy to the facts it was proposed to explain"; and further attention to the subject only serves to confirm my conviction that the above statement was not inconsiderately made. Mr. Wallace says that the 'first thing we are taught' by a consideration of the facts involved, is "that there is no incapacity in the female sex among birds to receive the same bright hues and strongly contrasted tints with which their partners are so often decorated, since whenever they are *protected and concealed* during the period of incubation *they are similarly adorned*."* In point of fact, however, this statement is far from correct, for it often happens that where the males are especially brilliantly colored and the females are exceptionally dull-colored, they either build domed nests or nest in places of concealment, as in the Superb Warblers (genus *Malurus*) of Australia, and the great family of Sunbirds (Nectariniidæ), etc.;† while on the

* The italics are Mr. Wallace's own.

† Numerous individual cases may be cited among many other families, where the rule is an open nest, and the exceptions of concealed or domed nests are presented by species in which the sexual contrast in the color of the birds is greater than among their near allies which build an open nest.

other hand nearly as many birds (probably *fully as many*, proportionately to their whole number) in which both sexes are among the dullest plumaged of all birds, build a domed nest or nest in holes. Take, for example, the great family of Wrens (Troglodytidæ), and especially the great South American family Dendrocolaptidæ, particularly its subfamilies Furnariinæ and Synallaxinæ, in which the species as a rule build a domed nest, either of mud or sticks. Some of these nests, as those of the genus *Synallaxis* and its allies, are among the most remarkable examples of bird architecture, being immense structures (compared with the size of the builders) of sticks, which they enter by narrow, winding passageways, or through long tubes of interlocked thorny twigs, the whole structure being obviously contrived for the purpose of keeping out enemies. Even birds of the genera allied to *Malurus*, already mentioned, consisting of species in which both sexes have plain and 'protective' colors, also build domed nests. Even among the Swallows and Martins it is the species having the plainest colors which build in holes in banks, or in the otherwise most concealed and protected situations. Again, the Creepers (genus *Certhia*) are sexually alike in color, and of eminently plain and protective tints, yet they nest in holes. The Nuthatches and Tits, at least many of them, are no more conspicuous in respect to coloration than perhaps the average of birds which build open nests. In the great family of American Warblers (Mniotiltidæ), one of its plainest members, the Ovenbird (*Siurus auricapillus*), and one of the few species of the family in which the sexes are alike, builds a domed nest, contrary to the rule prevailing in the family. In short, scarcely a family or subfamily among Passerine birds can be named in which we do not meet with cases of just this character, some of them presenting many such. Consequently *it is not the rule* that birds which breed in domed nests or in places of concealment are brightly or gayly colored, and that "whenever they [the females] are *protected and concealed* during the period of incubation *they are similarly adorned*" (i.e., with "the same bright hues and strongly contrasted tints of their partners").

In view of the real facts in the case, it seems not rash to assume that concealment of the female during the period of incubation has nothing, or at least very little, to do with this method of nidification, since it not only does not bear out the theory erected

upon a misapprehension of the facts in the case, but is susceptible of a far more rational explanation. As already noted, Mr. Dixon frankly admits that in the case of dull-colored birds which build covered nests or which nest in holes, "other advantages may be gained irrespective of concealment," and concealment in such cases is considered as unnecessary. These advantages may be in some cases shelter from rain, protection from the sun, or sudden changes of temperature, or greater security from enemies, or concealment of the eggs, which are generally, under such circumstances of nidification, *white*, or at least conspicuous in coloration. Here, it seems to me, comes in the only function of concealment—namely, that of the *eggs* rather than the sitting female.

In my former paper on this subject I referred to this latter point in the following words: "In conclusion, I desire to call attention to an interesting coincidence between the manner of nesting among birds and the color of the eggs, and one so striking that it is almost surprising that some ingenious theorist has not seized upon it as a basis for a 'theory of birds' nests,' either independently or as a modification of that proposed by Mr. Wallace. It curiously happens that nearly all the birds that nest in holes, either in the ground or in trees, lay *white eggs*, embracing, for instance, all the Woodpeckers, Kingfishers, Bee-eaters, Rollers, Hornbills, Barbets, Puff-Birds, Trogons, Toucans, Parrots, Paroquets, and Swifts, while only occasionally are the eggs white in species which build an open nest. In only two or three groups of land birds, co-ordinate with those just named, that build an open nest, are the eggs white, namely, the Owls, Humming-Birds, and Pigeons. On the other hand, in only two or three small groups of species that nidificate in holes are the eggs speckled or in any way colored. There is, in fact, a closer relationship, or rather a more uniform correlation, between the color of the eggs and the manner of nesting than between the color of the female parent and the concealment or exposure of the nest. There are, however, here apparently too many exceptions to bring this coincidence into the relation of cause and effect."* Further examination of the matter, however, shows that the coincidence of white eggs and a covered or concealed nest is much more general than the above quotation indicates, the ex-

* Bull. Nutt. Orn. Club, III, p. 32.

ceptions to the rule being very rare; for to the above groups must be added the hundreds of species of Passerine birds which build a domed nest, as the Malurine birds, the Weaver Birds, the Munias, the Willow-warblers, the Sunbirds, the Pittas, the Tailor Birds, the great Synallaxinine series, and *many* others. In all these cases the eggs as a rule are pure white, and when deviating from this are simply pale bluish white, or white with a few minute specks, or lustrous white speckled with reddish, in in such a way as in nowise to render the eggs less conspicuous than if pure white. Mr. Dixon, in his paper now under notice, has called attention to the same facts, and commenting on this coincidence says, "This law is almost universal."*

If we pass to water birds, we find many of the Petrels nesting in holes and laying white eggs: and that the Ducks and Grebes lay white or nearly white eggs, and, though building an open nest, cover them on leaving them; and, it may be added, the same is true of many Pheasants and Partridges.

There are, on the other hand, birds which lay white eggs in an open nest, but the number is few in comparison with those which lay white eggs in nests affording concealment, or colored eggs in open nests. Again, some eggs laid in open nests are intensely white in ground-color, with markings which tend to make them more conspicuous rather than contribute to concealment. Such are the eggs of most of the great group of Tyrant Flycatchers of America. Of species laying white eggs in open nests, the Pigeons and the Hummingbirds are prominent examples, embracing as they do a multitude of species. To this list may be added a few ground-nesting Hawks and Owls which lay white, or at least whitish, eggs, and the Herons, Storks, Pelicans, and Cormorants. In respect to these exceptions, it may be said that the Tyrant Flycatchers are especially watchful of their nests and courageous in their defense, and succeed in driving away even predacious birds greatly exceeding them in size. The Pigeons and some Goatsuckers, as Mr. Dixon suggests, build a very

* He adds, however, as a part of the same sentence, "and, curiously enough, white eggs are correlated to a great extent with the brilliant plumage of the bird; for we have already seen how so many of these showy birds breed in covered nests." This latter fact, however, loses much of its significance when we remember that nearly as many other birds of equally brilliant plumage lay *colored* eggs in *open* nests, and also that nearly as many dull-colored birds as bright-colored ones lay *white* eggs in nests which afford them concealment.

slight and inconspicuous nest, and, as a rule in dense cover. He also adds, very pertinently, respecting the Herons, Cormorants, Pelicans, and Storks, that in these cases it is quite evident "that the birds by there own prowess alone shield their eggs from danger: besides, most of these birds are gregarious, and are well able to beat off any enemy that is likely to approach, if not singly, by uniting for the purpose, so that it is of no special advantage for them to conceal their eggs."

In respect to spotted eggs, laid in covered nests, in which the color is as much 'protective' in character as in the case of their allies which lay in open nests, they usually belong, it may be stated, to groups which as a rule breed in open nests, as the Magpie, for example, among the Corvidæ.

As a rule, spotted eggs are laid in open nests, and are in most cases 'protective' in coloration, as is the case generally with ground-nesting birds, in which the tints of the eggs often strikingly harmonize with their surroundings. In the case of tree-nesting species, the color of the eggs is less 'protective'; but the position of the nest is in a measure an element of safety, at least in respect to non-scansorial enemies, like many of the smaller mammals, which prey more or less upon the eggs or nestlings of ground-nesting birds.

It is therefore evident that the color of the eggs has an intimate relation to the manner of nesting, white eggs as a rule being laid in covered nests or concealed nesting-sites. But a distinction should be made in respect to different kinds of covered nests, in reference to the matter of security against enemies. The bulky nests of the Synallaxinæ, composed of coarse, interlocked, often thorny sticks and twigs, or the globular mud nests, the walls of which become of a brick-like hardness, of the species of *Furnarius*, may well be classed, on the ground of protection against enemies, with nests built in excavations in trees or in the earth, while the loosely constructed domed nest can scarcely serve otherwise than for concealment of the eggs, or young, or the sitting bird. The large size of such nests, however, must sometimes render them a too conspicuous object to give any real advantage, but in other cases, and generally when placed on the ground, the nest itself is artfully concealed. In regard to nesting in holes, in trees or the earth, the object gained is obviously protection in the broader sense rather than concealment of the female

during incubation, *on account of her bright colors*. It seems therefore needless and wholly gratuitous to resort to any theory of sexual selection to account for the diverse methods of nest-building among birds. Really, however, it is not the sitting bird, in the case of open nests built in trees, whether she be bright or dull-colored, or the contents of the nests, whether eggs or nestlings, that lead to its discovery so much as the size and conspicuousness of the nest itself. Neither is the sitting bird herself so much in danger as her charge, be it either eggs or nestlings. The chief enemies of tree-nesting birds are squirrels, monkeys, other aboreal mammals, and nest-robbing birds, to all of which the nestling birds, particularly if very young, are as welcome as the eggs, and in general they are much less conspicuous objects than are either the eggs or the sitting female.

Now a word on another point. Mr. Wallace, and after him Mr. Dixon and others, in discusing the question How do young birds learn to build their first nest? claim that 'instinct' has nothing to do with the matter,—that they learn by observation and are guided by memory! Says Mr. Wallace: "It has, however, been objected that observation, imitation, or memory, can have nothing to do with a bird's architectural powers, because the young birds which in England are born in May or June, will proceed in the following April or May to build a nests as perfect and as beautiful as that in which it was hatched, although it could never have seen one built. But surely the young birds *before* they left the nest had ample opportunities of observing its *form*, its *size*, its *position*, the *materials* of which it was constructed, and the manner in which those materials were arranged. Memory would retain these observations till the following spring, when the materials would come in their way during their daily search for food, and it seems highly probable that the older birds would begin building first, and that those born the preceding summer would follow their example, learning from them how the foundations of the nest were laid and the materials put together. Again we have no right to assume that young birds generally pair together," etc. Mr. Dixon restates the case in much the same way. Alluding to 'blind instinct' as a factor in the case, he says: "To credit the bird with such instinct, which because it seems so self-evident is taken to be matter of fact, is to admit that it

posesses intellectual powers infinitely superior to those of man; whilst the evidence that can be gathered on the subject all goes to show that its intellectual powers are of precisely the same kind as man's, but some of them, of course, are infinitely inferior in degree, whilst others are unquestionably superior." He assumes that *imitation*, *memory*, and hereditary habit, 'play the minor parts.' "To credit birds," he says, "with such marvellous power as blind and infallible instinct in building their nests would be to place them far beyond man himself in intelligence, and allot to them a faculty which is superhuman .... A bird's intellectual powers advance towards maturity much more quickly than in the human species. A young bird three or four days old is capable of considerable powers of memory and observation, and during the time that elapses in which it is in the nest it has ample opportunity of gaining an insight into the architecture peculiar to its species. It sees the position of the nest, it notes the materials, and when it requires one for itself, is it so very extraordinary that, profiting by such experience, it builds one on the same plan? Again, birds often return to the place of their birth the following season, and possibly see the old home many times ere they want one for themselves. This, aided by the strong hereditary impulse to build a nest similar to the one in which they were born, inherited from their parents, aids them in their task." This reasoning, I am free to confess, strikes me, to say the least, as extraordinary! A degree of mental power, at least of memory and of imitation, is ascribed to young birds which is not only 'superhuman,' but of which there is neither proof, nor even possibility of proof. Mr. Dixon has the 'three or four days old' nestling taking note of and memorizing its surroundings before, in the case of the higher Oscines, *it has the power to even open its eyes!* Yet with all this ascribed precosity and keenness of observation, and this wonderful power of memory and imitation in young birds, Mr. Dixon finds it neccessary to call in the aid of "a strong hereditary impulse to build a nest similiar to the one in which they were born," which is more than a half-way admission of all that is implied in the modern interpretation of instinct, or the 'blind instinct' of the non-scientific writer. It we interprete instinct as 'inherited habit,' what better explanation do we need of the ability of young birds to build a nest like that of their parents or of their species? In view of the slight evidence available as to how much a nestling bird can

take cognizance of its surroundings, and make mental note of them for purposes of imitation at a remote future, does not the assumption of such extraordinary powers of imitation and memory border upon absurdity? To extend the theory, which it is perfectly legitimate to do, to other classes of animals, does the tadpole, or the embryo fish (in the case of the nest-building species) also remember the exact position, structure and materials of its maternal nest? Does the young turtle remember throughout the long years of its adolescence the precise nature of the spot from which it emerged, so as to select a similar place for its own eggs? Or does the larva of an insect remember, through its various stages of metamorphosis, the exact arrangement of the egg from which it was hatched in relation to the eggs of its brother larvæ so distinctly as to be able to deposit its own eggs in a similar situation and similar order of arrangement? Why, indeed, the idea that birds are guided by 'instinct,' taking the term as interpreted by modern science, is so repugnant to a certain class of minds, or why they will persist in denying that *any evidence in its favor exists*, is to me at least incomprehensible. In short, I agree exactly with Mr. Seebohm in his footnote appended to Mr. Dixon's essay, in which he says: "I regard the word Instinct as the popular term for the mysterious impulses which scientific men call Hereditary Habit; and I think that it plays a great part, an overwhelmingly great part, not only in Bird-nest building, but in every other action of every animal, man included . . . . If Hereditary Habit have the lion's share in the production of a birds' nest, we must allow that Memory, Imitation, and a rudimentary form of Reason also play their subordinate parts." In these few words, it seems to me, we have the sum of the whole matter, and a rational answer to the question of how young birds build their first nest.

NOTES ON SOME OF THE BIRDS OF PUEBLO, COLORADO.

BY CHARLES WICKLIFFE BECKHAM.

THE following observations were made principally in the immediate neighborhood of Pueblo, Colorado, during the season of 1883.